

Amendment Under 37 C.F.R. § 1.111
Serial No.: 10/070,534
SUGHRUE MION, PLLC Ref: Q68538

REMARKS

Claims 1-5 are all the claims pending in the application. By way of this Amendment, Applicants have amended claims 1-3 and 5. For the following reasons, it is submitted that these claims patentably distinguish over Japanese Patent No. 3-37989 (JP '989), Japanese Patent No. 360056417 (JP' 417) and Kato (USP 4,842,818) applied by the Examiner under § 103.

The minor objection to claim 2 has been overcome. With respect to the IDS filed March 7, 2002, Applicant submits that the Examiner improperly failed to consider JP-61-35556. Specifically, Applicants provided the Examiner with a copy of the International Search Report discussing the relevance of JP 61-35556 (a copy of which is attached). The Examiner is kindly requested to reconsider this reference. A copy of PTO/SB/08/A & B is attached for the Examiner's convenience.

The Claimed Invention

The gist of the present invention resides in that the double tapered steel wire (S) of the present invention has its small-diameter portions (24) be substantially equal to its large-diameter portions (21) in tensile strength by: evenly heating these portions (24, 21) over the entire length of the steel wire (S); and, quenching and/or tempering these portions (24, 21). As described in the "Field of the Invention" in the specification, the present invention relates to a double tapered steel wire and a method and an apparatus for continuously heat treating the double tapered steel wire.

Amendment Under 37 C.F.R. § 1.111
Serial No.: 10/070,534
SUGHRUE MION, PLLC Ref: Q68538

The above-mentioned heat treatment, which includes a quenching process and/or a tempering process of the double tapered steel wire (S) following a heating process of the steel wire (S), is not considered in JP'989 or JP'417); and, Kato et al. (US Patent 4,842,818) , all cited by the Examiner.

JP'989

JP'989 discloses an induction heating apparatus, which comprises a diameter measuring means for measuring a diameter of a workpiece (5), wherein the workpiece (5) is transferred at a transfer velocity and heated at a temperature rise ratio. In the apparatus of JP'989, both the transfer velocity and the temperature rise ratio of the workpiece (5) are controlled on the basis of the diameter of the workpiece (5) thus determined by the diameter measuring means.

Consequently, the present invention, which relates to a quenching process and/or a tempering process performed after completion of a heating process of a workpiece or double tapered steel wire (S) itself, is quite different from JP'989's apparatus for controlling both the transfer velocity and the temperature rise ratio of the workpiece (5) on the basis of the diameter of the workpiece (5) having been measured by the diameter measuring means of the apparatus.

JP'417

JP'417 discloses a controlling method of tapered rod working device, in which the tapered rod is partially modified in temperature. On the other hand, in the heat treatment of the present invention, the double tapered wire (S) is evenly heated over the entire length of the

tapered wire (S) not partially modified in temperature. In this respect, the present invention is quite different from JP'417's method.

Kato et al.

Kato et al. discloses a method for manufacturing (more specifically, shaping a workpiece into) a tapered rod for a coil spring, in which: as described in column 2, lines 24-38, a workpiece or pre-selected metallic material is imparted locally temperature gradient in the axial direction by heating; and, then axially stretched by pulling, so that the workpiece is formed into a tapered rod having a locally varied diameter in the axial direction according to the gradient pattern of the heating temperature. As is clear from the above, Kato et al. discloses a method for shaping the workpiece into the tapered rod, not disclose any heat treatment of the thus completed tapered rod itself. Due to this, Kato et al. does not disclose nor suggest the present invention.

Differences between the cited References and the present invention:

1. Differences between JP'989 and the present invention:

a). In JP'989: a diameter of a straight steel rod is measured to obtain a measurement value of the steel rod; and, the steel rod having such a measurement value is then heated under an optimum heating condition determined by the measurement value of the steel rod. As is clear from the above, the apparatus disclosed in JP'989 has its heating means controlled on the basis of such a measurement value of the steel rod. In this respect, some similarity is observed between the apparatus of JP'989 and that of the present invention.

b). However, in JP'989: conducted is a mere heating process for evenly heating the straight steel rod; and, there is no concept of a quenching process and/or a tempering process following such a heating process as disclosed in the present invention.

c). In other words, JP'989 teaches a mere heating process for heating the straight steel rod to a predetermined temperature, which temperature is required in a subsequent press-forging process of the steel rod thus heated. Consequently, JP'989 does not disclose nor suggest the concept of the present invention of partially modifying the double tapered steel wire (S) in temperature in its heating process to modify in tensile strength thereof.

2. Differences between JP'417 (i.e., Reference 2) and the present invention:

a). In JP'417, the steel rod is partially heated and stretched under the influence of a pulling force or tensile force applied thereto to reduce the thus heated portion of the steel rod in diameter, so that a double tapered wire is prepared. In JP'417, such a tensile force is applied to the steel rod by means of a pair of tension rollers 16. Incidentally, in Kato et al., a tensile force is applied to the workpiece through a pair of chucks 2 pulled by means of a hydraulic cylinder or like suitable means. In this respect, JP'417 differs from Kato et al..

b). The JP'417 partially reduces a metallic material or workpiece 1 in physical strength by partially heating the workpiece 1, and has the thus heated portion of the workpiece 1 to an axial tensile force to reduce the heated portion of the workpiece 1 in diameter to form the workpiece 1 into a tapered rod. As is clear from the above, JP'417 discloses a controlling method of a tapered rod working device, in which method both the tension roller (i.e., transfer roller) 16 and the temperature of the workpiece 1 in such a partial heating process of the

workpiece 1 are controlled. In contrast with this, the present invention does not relate to such a controlling method of JP'417 at all. The present invention relates only to heat treatment that is a quenching process and/or a tempering process of the workpiece, which follows a heating process of the workpiece. Consequently, it is also possible for the present invention to employ JP'417's device in its heat treatment of the workpiece.

c). JP'417 discloses a cooling device 9 (shown in Fig. 1) for cooling the workpiece immediately after completion of a diameter-reducing process of the workpiece or tapered rod. More specifically, in the JP'417, heated is only a workpiece's portion to be reduced in diameter. Consequently, such a workpiece's portion thus heated can be reduced in diameter and therefore quenched in the subsequent cooling device 9. In contrast with this, the remaining portion of the workpiece other than the workpiece's portion thus heated remains unheated and therefore unquenched. In this respect, the method of JP'417 quite differs from the present invention in effect. Namely, in the present invention, the workpiece including both the large-diameter portions and the small-diameter portions is evenly heated to the same temperature over the entire length of the workpiece, and is therefore capable of obtaining the same tensile strength over the entire length of the workpiece. This technical idea of the present invention does not disclosed nor suggested in JP'417 at all.

d). Although the cooling device 9 is disclosed in JP'417 for cooling the workpiece after completion of its mere heating and therefore diameter-reducing process, JP'417 does not disclose nor suggest any heat treatment (i.e., a quenching process and/or a tempering process) of the workpiece. In other words, JP'417 does not disclose nor suggest any method for improving the

workpiece in tensile strength by cooling the workpiece, because in JP'417, though working temperatures of the workpiece required in its diameter-reducing process are shown in Fig. 4, JP'417 does not teach any physical strength of the product or completed workpiece at all.

e). Even when a large-diameter portion of the workpiece is heated together with a small-diameter portion of the workpiece in the method of JP'417, since the small-diameter portion which is required to be reduced in diameter must be heated to a temperature higher than that of the large-diameter portion not required to be reduced in diameter, the workpiece having been cooled by means of the subsequent cooling device 9 has its small-diameter portion larger in tensile strength than its large-diameter portion. Consequently, in the method of JP'417, when the large-diameter portion of the workpiece is quenched at a predetermined quenching temperature of the large-diameter portion so as to obtain a predetermined tensile strength in this large-diameter portion, the small-diameter portion is quenched at higher temperature than the above-mentioned quenching temperature of the large-diameter portion. However, the quenching temperature of the small-diameter portion is higher than a predetermined quenching temperature of the large-diameter portion. Due to this, the small-diameter portion of the workpiece having been quenched at a quenching temperature excessively higher than a quenching temperature required by the large-diameter portion of the workpiece is impaired in tissue or becomes coarser in tissue, which results in a poor product too fragile in its small-diameter portion in use. On the other hand, when the small-diameter portion of the workpiece is quenched at its suitable quenching temperature, since such a suitable quenching temperature of the small-diameter portion of the workpiece is too lower than the quenching temperature required by the large-

diameter portion of the workpiece, it is not possible for the large-diameter portion of the workpiece to obtain a predetermined physical strength.

f). In other words, the method of JP'417 lacks the technical idea or concept of the present invention for having the small-diameter portion of the workpiece be substantially equal to the large-diameter portion of the workpiece in tensile strength. Consequently, in contrast with the present invention, it is not possible for the method of the JP'417 to have the small-diameter portion of the workpiece be substantially equal to the large-diameter portion of the workpiece in tensile strength.

3. *Differences between Kato et al. and the present invention:*

a). In Kato et al., as is in the case of JP'417, a metallic material in a linear state or workpiece is partially heated, chucked at its opposite end portions by means of chucks 2, and axially stretched through these chucks 2 by means of a hydraulic cylinder or like means so as to have the thus heated portion of the workpiece reduced in diameter under the influence of heat and the tensile force applied thereto, whereby the workpiece is formed into a tapered rod. In applying the tensile force to the workpiece, Kato et al. uses the chucks 2, whereas JP'417 uses a pair of tension rollers 16. Only in this respect, the Kato et al. differs from JP'417.

b). Kato et al. discloses only a method for forming or shaping the workpiece into a tapered rod. In Kato et al., there is not disclosed nor suggested any idea of heat treatment of the workpiece. Heating of the workpiece performed in Kato et al. means a mere heating process for softening a portion of the workpiece in preparations for a diameter-reducing process of the thus

heated and therefore softened portion of the workpiece. This is clear from the embodiments described in Kato et al., illustrating only the relationship between the temperatures of the workpiece thus heated and the size of the workpiece thus varied under the diameter-reducing process of the heated portion of the workpiece. There is not described any heat treatment of the workpiece in Kato et al..

Arguments against the Examiner's Objections:

Based on the above-mentioned differences between the cited. Applicants respectfully traverse the Examiner's rejections for the following reasons.

IN THE DETAILED ACTION

1. Page 2, paragraph No. 2:

The Examiner argues as follows:

“Claims 1 to 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Japanese Patent 3-37989 cited by applicant in IDS dated March 7, 2002, alone or in view of the English abstract of Japanese Patent 360056417.” (hereinafter referred to as the rejection 1).

As for the JP'989, JP'989 does not disclose nor suggest any heat treatment of a workpiece 5. More particularly, JP'989 discloses a mere heating process of the workpiece which is constructed of a straight or constant-diameter steel rod 5. The rod 5 is heated to its plastic deformation temperature in the heating process, and then subjected to a press-forging process so that the steel rod 5 is plastically deformed using a press into a product.

As is clear from the above, the JP'989 does not disclose nor suggest the heat treatment of the present invention at all.

As for the English abstract of JP'417 cited by the Examiner, the Examiner argues in the DETAILED ACTION, page 2, paragraph No. 2.

2. Page 2, paragraph No. 3:

The Examiner argues as follows:

“The English abstract of JP'989 discloses a method for continuously heat treating a steel wire comprising the steps of continuously detecting a diameter of said steel wire, and then controlling the amount of energy required for induction heating said steel wire based on the detected wire diameter. Hence the amount of energy released is proportional to a wire diameter of said steel wire having been detected.” (hereinafter referred to as the rejection 2).

As for the term “heat treating” used by the Examiner in the rejection 2, JP'989 does not use the term “heat treating” at all. Disclosed in JP'989 is a mere heating process which is required only in softening or lowering a metallic material or workpiece 5 in physical strength by heating in preparation for a subsequent plastic deformation process (i.e., forging) of the thus heated workpiece 5.

As is clear from the above, JP'989 does not consider any heating treatment of the final product in contrast with the present invention. In the heat treatment of the present invention, a workpiece or double tapered steel wire (S) assuming its final product shape is heat treated through a quenching process and/or a tempering process of the workpiece (S), both of which processes are intentionally performed in accordance of the present invention so as to make a small-diameter portion of the tapered wire (S) substantially equal to a large-diameter portion of the wire (S) in tensile strength. In order to clarify the heat treatment of the present invention in

this respect, claims 1-3 are currently amended to further define a technical idea “heat treatment” as a quenching process and/or a tempering process of a double tapered steel wire assuming a final product shape.

3. Page 2, paragraph No. 4:

The Examiner argues as follows:

“Even though prior art does not specifically teach a double tapered steel wire as recited by the claims, such would not be a patentable different since the JP’471¹ uses a wire in general which would include tapered wire.” (hereinafter referred to as the rejection 3).

Applicants respectfully argue rejection 3, as follows:

The JP’417 discloses a tapered steel rod, which is formed by performing a mere heating process of a constant-diameter steel rod to lower a predetermined portion of the rod in physical strength by heating in preparation for a subsequent plastic deformation process of the thus heated portion of the rod, through which deformation process the constant-diameter rod is formed into a final product shape (i.e., tapered rod shape).

This plastic deformation process is carried out by axially stretching the workpiece 1 by means of a pair of tension rollers 16, which are rotatably driven at higher peripheral velocities than the corresponding peripheral velocities of a pair of upstream-side constant-velocity feed rollers 2 so as to realize an axial stretching operation of the heated workpiece 1. This stretching

¹ Clearly the Examiner meant to refer to JP’417.

operation of the workpiece 1 results in plastic deformation of the workpiece 1 into a final product that is a tapered rod assuming a final product shape.

As is clear from the above, disclosed in the JP'417 is a mere heating process of the workpiece (i.e., constant-diameter rod). Any heat treatment of a final product (i.e., tapered rod) itself is not disclosed nor suggested in the JP'417 at all. On the other hand, heat treatment of a double tapered steel rod assuming a final product shape is the gist of the present invention.

Therefore, Applicants submit that it is not easy for those skilled in the art to find the heat treatment of the present invention even when those skilled in the art combine JP'989 with JP'417.

4. Page 2, paragraph No. 5:

The Examiner argues as follows:

“Even though the prior art does not teach a double tapered steel wire having its small-diameter portions be equal to its large-diameter portions in tensile strength as recited by claim 2, such equal strength values would be expected. Note JP'989 obtains uniformity in heat treatment by accurately controlling the temperature in relationship with the diameter of wire which would be in turn produce uniformity in physical properties that would include tensile strength.”
(hereinafter referred to as the rejection 4).

Claim 2 is currently amended to further define the present invention's technical idea “heat treatment” as a quenching process and/or a tempering process of a double tapered steel wire (S) assuming a final product shape itself.

JP'989 discloses a mere heating process, which is required in softening or lowering a workpiece 5 in physical strength in preparation for a subsequent plastic deformation (i.e., forging) process of the workpiece 5 into a final product shape. Such a forging process of the workpiece 5 is conducted using a press.

As is clear from the above, JP'989 is a mere heating process of the workpiece (which does not assume a final product shape) for exclusively lowering the workpiece in physical strength in preparation for the subsequent forging process of the workpiece.

Due to this, JP'989 alone or even in combination with the JP'417 does not teach the present invention's heat treatment at all, because in the present invention, the workpiece (i.e., double tapered steel wire S) assuming its final product shape at the beginning of the heat treatment; and, the workpiece has its small-diameter portions be substantially equal to its large-diameter portions in tensile strength by performing the heat treatment of the double tapered steel wire (S) itself at optimum heat treatment temperatures which are inherent in this final product shape.

In connection with this rejection 4, the Examiner specifically argues that "Note the JP'989 obtains uniformity in heat treatment by accurately controlling the temperature in relationship with the diameter of wire which would be in turn produce uniformity in physical properties that would include tensile strength.".

Although the Examiner refers to "heat treatment" of a workpiece in this rejection 4, JP'989 does not disclose nor suggest any heat treatment including a quenching process and a tempering process of the workpiece.

As already described above, in JP'989: conduction is a mere heating process for evenly heating the workpiece or straight steel rod; and, there is no concept of a quenching process and/or a tempering process following such a heating process as disclosed in the present invention.

In other words, JP'989 teaches a mere heating process for heating the straight steel rod to a predetermined temperature, which temperature is required in a subsequent press-forging process of the steel rod thus heated. Consequently, JP'989 does not disclose nor suggest the present invention teaching a concept or technical idea for partially modifying the double tapered steel wire (S) in temperature in its heating process to modify in tensile strength thereof.

Still Further, JP'989 does not disclose nor suggest any improvement of the workpiece in mechanical properties.

Therefore, Applicants respectfully submits that it would not be obvious for those skilled in the art to find out the present invention's heat treatment at the time when the present invention was made.

5. Page 3, paragraph No. 6:

The Examiner argues as follows:

"In regard to apparatus claims 3 and 5, JP'471² abstract discloses an induction heating means, a wire diameter means and a control means for controlling the amount of energy supplied." (hereafter referred to as the rejection 5).

² Clearly the Examiner meant to refer to JP '417.

Applicants respectfully argue against objection 5, as follows:

JP'417 discloses a mere heating process of the workpiece that is a constant-diameter rod.

In other words, as already described in the argument against rejection 3, such a mere heating process of the constant-diameter rod is performed in order to soften the workpiece in physical strength in preparation for a subsequent plastic deformation process of the workpiece, in which deformation process the workpiece is axially stretched to permit its heated portion to be axially elongated and radially contracted to reduce a diameter of the heated portion, so that a tapered portion of the workpiece is produced through plastic deformation of the heated portion of the workpiece, whereby the workpiece is formed into a final product that is a tapered rod. Any heat treatment of a final product (i.e., tapered rod) itself is not disclosed nor suggested in the JP'417 at all. On the other hand, heat treatment of a double tapered steel rod assuming a final product shape is the gist of the present invention.

Therefore, Applicants submit that it would not have been obvious for those skilled in the art to find the heat treatment of the present invention even when those skilled in the art combine the JP'989 with JP'417.

6. Page 3, paragraph No. 7:

The Examiner argues as follows:

“Even though JP'798³ does not teach the quenching and tempering step recited by claim 4, such steps are conventional steps in producing wire as shown in JP'417 and hence would be an

³ It is assumed that the Examiner meant to refer to JP '989.

obvious modification well within the skill of the artisan to incorporate.” (hereafter referred to as the Objection 6).

Applicants respectfully argue against the objection 6, as follows:

The gist of the present invention defined in the apparatus claim 4 resides in that: a workpiece that is a double tapered steel wire (S), which substantially assumes the same shape as that of a final product at the beginning of its heat treatment, is subjected to a heating process, a quenching process and/or a tempering process in this order through the apparatus to become a final product thus heat treated.

In contrast with this, JP’989 discloses a mere heating process of a workpiece 5 for softening the workpiece in physical strength in order to facilitate a subsequent plastic deformation (i.e., forging) process of the thus heated workpiece. Through this forging process, the thus heated workpiece is deformed into a final product. Consequently, in JP’989, the workpiece differs from its final product in shape. Due to this, even when the workpiece is heat treated in JP’989, such heat treatment of the workpiece of JP’989, is quite different in effect from the heat treatment of the present invention in which the workpiece (i.e., double tapered steel wire S) keeps its original shape even after completion of the heat treatment.

As is clear from the above in view of the prior arts, the heat treatment of the present invention is not conventional and has advantages in productivity and in cost reduction.

7. Page 3, paragraph No. 8:

The Examiner argues as follows:

“Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over the English abstract of JP360056417 or Kato et al. (US Patent 4,842,818).” (hereafter referred to as the rejection 7).

In view of the amendment to claim 2, the claimed workpiece is a double taper steel wire (S) that substantially keeps its original shape throughout its heat treatment.

In contrast with this, the workpiece disclosed in the English abstract of JP’417 is a metallic material 1 which assumes a constant-diameter rod shape. This workpiece 1 does not keep its original shape throughout its heating process in the JP’417. More specifically, in the vicinity of the end of the heating process section in the JP’417, the workpiece 1 that is a constant-diameter rod 5 is drastically changed in shape into a tapered rod, as is clear from Fig. 1 of the JP’417. This drastic change of the workpiece 1 in shape into the tapered rod makes it impossible for the thus obtained tapered rod of the JP’417 to have its small-diameter portion substantially equal to its large-diameter portion in tensile strength, because the drastic change of the workpiece in shape leads to a drastic change in physical properties of the workpiece 1, which makes it impossible for the tapered rod 1 to have its small-diameter portions equal to the large-diameter portions of the tapered rod in tensile strength. Consequently, JP’417 does not disclose nor suggest a double tapered steel wire S defined in claim 2 (amended).

As for Kato et al., a workpiece that is a metallic material 1 as disclosed in the Kato et al. also fails to keep its original shape throughout its heating process. As is clear from a description appearing in column 2, line 31 in the Kato et al., the metallic material or blank is deformed into a

Amendment Under 37 C.F.R. § 1.111
Serial No.: 10/070,534
SUGHRUE MION, PLLC Ref: Q68538

desired tapered rod in the method of Kato et al. through a drastic change in shape of the workpiece 1.

As is in the case of JP'417, and Kato et al. also does not disclose nor suggest a double tapered steel wire S defined in claim 2 (amended).

Consequently, the JP'417 alone or in combination with the Kato et al. does not disclose nor suggest the double tapered steel wire S of the present invention.

8. Page 3, paragraph No. 9:

The Examiner argues as follows:

“The abstract of JP'417 and Kato et al., each teach a tapered steel wire produced with a controlled heat treatment based on dimensions of said wire to produce uniformity in properties. Even though tensile strength as recited by claim 2 is not taught by prior art, such would be expected since uniform heat treatment is performed, and in absence of proof to the contrary.” (hereafter referred to as the Objection 8).

Although the Examiner argues that the “uniform heat treatment” of the workpiece is performed in each of the abstract of JP'417 and Kato et al., this is not true.

Performed in the Kato et al. is a temperature-gradient heating (see column 2, lines 41), which heating therefore differs from the uniform heat treatment of the workpiece of the present invention.

As for the remaining JP'417, JP'417 also does not disclose nor suggest any uniform heat treatment of the workpiece (i.e., constant-diameter steel rod) at all. Disclosed in the JP'417 is a

Amendment Under 37 C.F.R. § 1.111
Serial No.: 10/070,534
SUGHRUE MION, PLLC Ref: Q68538

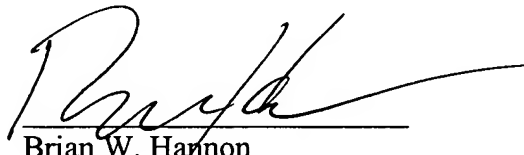
mere heating process of the workpiece for facilitating a subsequent plastic deformation process of the workpiece (i.e., constant-diameter steel rod) into a final product that is a tapered rod.

As is clear from the above, Kato et al. alone or in combination with JP'417 does not teach nor suggest the heat treatment of the present invention of the double tapered steel wire S.

In view of the above, it is submitted that the claims patentably distinguish over the cited art. Thus, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


Brian W. Hannon
Registration No. 32,778

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

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